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Phenomenon of Digital Literacy in scope of European cross-curricular comparison

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Abstract

Focusing on digital literacy as a frame of reference for globally-required digital competence, the problem of its implementation within the sphere of education emerges. This paper will report the findings of the first concluded project phase of a dissertation thesis at the Faculty of Education of Trnava University in Trnava (Slovak Republic), concentrating on how digital competence is defined in European educational systems and how it is specified in actions within the primary stage. The purpose of this project phase was to determine a condition of explicitly defined digital competency within the national curricula of selected European nations (Slovak, Czech, Polish, English and Irish), and to compare the findings to the Slovak National Educational Program (ŠVP) as a national primary stage curriculum (ISCED1) with regards to its subjects and grade specification. In the first phase of dissertation project, the content analysis used a qualitative method of pedagogical research with a comparison of categorised findings. Findings about divergence between analysed West and East European curricula will be interpreted in detail (including references within content and performance standards). Potential for improvement in the sphere of digital competence definition for the primary stage will be closely indicated and specified. The paper will conclude with recommendations and concrete proposals for the fractional adoption of incentives underlying a distinct base for the realisation of the research project task, within the scope of the dissertation thesis.

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Keywords: curriculum, digital competence, digital literacy, digital technlogy, national educational program, standards

1. Introduction

The process of digitalisation has been widely developing within European education systems in recent years. In

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the Slovak educational system, concepts and strategies concentrating on the digitalisation of particular educational stages are realised on a long-term basis, as well. According to the digitalisation strategy for regional education (Ministry of Education, Science, Research and Sport of the Slovak Republic [MŠSR], 2008), three pillars *(People, Infrastructure and Content)* as the fundamentals for the processes of digitalisation development are required. One of the defined goals of the strategy is to improve the quality of all types and grades of schools by establishing surroundings for students that enable them to use the potential of digital technology (DT), resulting in the process of life-long learning optimisation. In context of the strategy target, the pillar of "Content" has a notable position, focusing on options of:

- integration of DT within the education process;
- fixation on essential student digital competence;
- providing adequate educational software and electronic educational contents;
- providing educational e-portals on the regional, national and international level within Europe;
- supporting research specialised in the impact of DT on education.

Conceptual and strategic results *(strategy for regional education digitalisation terminated in 2011)* directly influence and modify the national educational programme (ŠVP), which is a national curriculum determining the level of student digital competence required at a particular educational grade. Primary education represents a substantive grade, in which the appropriateness of educational content standards and performance standards of pupils, based on educational content that pupils are supposed to vindicate, is crucial. In this regard, analysis of the impact of strategic results on ŠVP for ISCED1 is realised and concluded in cross-curricular comparison within European nations (Slovak, Czech, English, Irish and Polish) to reflect on how innovative the strategic results are and what concrete actions they have on increasing student digital competence in particular nations.

The Department of Mathematics and Computer Science at the Faculty of Education of Trnava University, as an institution that prepares future teachers for pre-primary, primary and secondary schools, reflects the changes connected to reforms at all education levels that occur on a long-term basis (Mišút, 2006; Gazdíková, 2007). On that basis, broad research activities oriented towards digital literacy and its theoretical and practical manifestation within the context of education have been realised. (Javorský, 2012).

2. Phenomenon of Digital Literacy

Education, as an important sphere of the information society, has to reflect actual changes and consider ways in which it can support the demands to provide quality conditions for human existence in the context of a social transformation process. Digital literacy, as a complex frame of specific diversified capabilities, represents an actual phenomenon within the social matrix, sourced in the developing potential of DT and required information literacy. Research by Eisenberg, Lowe and Spitzer (1998) summarises that in context of education information literacy, where information literacy skills must be taught in the context of the overall process. It adds that instruction of these skills must be integrated into the curriculum and reinforced both within and outside of the educational setting to be successful. Information literacy represents an essential framework of competences (knowledge and skills), necessary for existence in an information society, as vital meta-skills to aid future success. Studies indicate that information literacy involves a series of partial implicit literacies (visual literacy, media literacy, network literacy, digital literacy) (Bawden, 2008; Eisenberg et al., 1998; Virkus, 2003). The quality of one's digital literacy is reflected by the level of cognitive and technological proficiency in which concrete capabilities (individual digital competence) occur *(Figure 1)*.

In general, digital literacy frameworks may be reflected in the use of digital technology (variety of hardware and software technology and applications), communication tools (accurate digital products and services for the purpose of information transmission) and networks (as data-transmission technologies) to access, manage, integrate, evaluate and create information in order to function in the information society (Education Testing Service [ETS], 2002). Regarding to ETS framework, digital literacy emerges within complex proficiencies. Cognitive proficiency refers to cognitive skills and general human literacy (everyday skills as reading, writing, numeracy, problem solving etc.), which is a crucial complement to technological proficiency (DT cognition and manipulative capabilities of their

accurate usage). On the basis of both proficiencies, human digital competence as a system of well-defined diversified meta-skills (related to the active usage of DT and its potential) is developed.

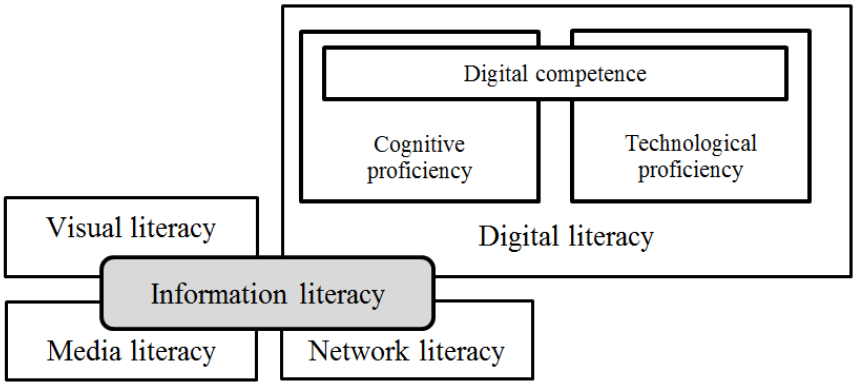

Figure 1 Digital competence and its relation within information literacy

The Educational Act *(accredited on 2008/05/22)* defines (within the section of term–specification) that competence is a frame of evincible capabilities to utilise knowledge, skills, attitudes and value orientation towards performing and executing functions according to standards within individual human exertion (Government of Slovakia, 2008). In the case of digital competence, capabilities reflect the actual innovative trends within the DT sphere and conclude within three interrelated fields *(Figure 2)*. Regarding field orientation, process activities focusing on individual student cognition, communication and presentation are required to be well-developed within the educational process in the appropriate educational grades.

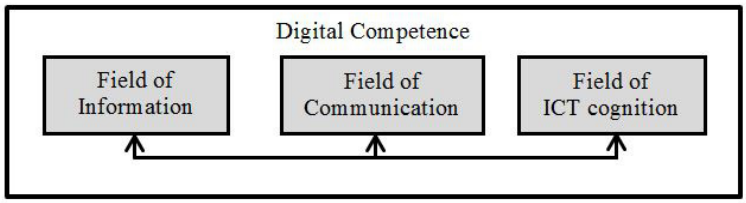

Figure 2 Fields of capabilities within digital competence

The European Parliament and Council (2006) concretises digital competence as one of the required key competences and summarises it within information processing (retrieve, assess, store, produce, present and exchange information), information legacy (awareness of issues around the validity and reliability of information), communication (communicate and participate in collaborative networks) and the understanding of DT (to understand computer applications, potential risks and innovative support). Within the fields of digital competence mentioned, standards reflecting and concretising individual capabilities are widely introduced (International Society for Technology in Education [ISTE], 2007). ISTE summarises a series of National Educational Technology Standards for Students (NETS*S) and concretises student capabilities, promoting digital competence integrally within the six standards (Table1).

Table 1 ISTE NETS*S 2007 conception

Conception	Standards
ISTE NETS*S 2007	1. Creativity and Innovation
	2. Communication and Collaboration
	3. Research and Information Fluency
	4. Critical Thinking, Problem Solving, and Decision Making
	5. Digital Citizenship
	6. Technology Operations and Concepts

3. Research description

Research in the first project phase of the dissertation thesis at the Faculty of Education of Trnava University in Trnava (Slovak Republic) concentrates on a reflection on how digital competence is defined in European educational systems. The main goal of the research was to reflect on explicitly defined actions supporting the development of students' digital competence at a particular grade of Slovak primary education according to ŠVP (as the first research phase), and to compare these findings with selected European nations (as the second research phase). Reflecting the main goals of research, the areas of investigation are:

- How is the concretisation of digital competence explicitly defined within the content of Slovak ŠVP for ISCED1, and within the student content and performance standards required for this grade?
- What level of divergence does the Slovak definition of digital competence represent from the point of East and West European cross-curricular comparisons?

Pedagogical research was processed using a strategy of open data-coding followed by categorisation. For the purpose of primary data interpretation, NETS*S as analytical categories were used (ISTE, 2007).

The first phase of analysis (as a qualitative method of pedagogical research) reflects the first field of investigation as defined above. Slovak primary education is systematically divided into four grades (pupils aged 6 to 10 years), in which programmes of study and subjects are specified (Table 2).

Table 2 System of Slovak programmes and subjects within ISCED1

Programme of study	**Subject**
Oral Language	Slovak Language and literature, Foreign Language
Mathematics and Data-processing	Mathematics , Computer Science
Nature and Society	Natural Science, Geography
Human and Values	Ethics , Religion
Human and Active work	Practical Training
Art and Design	Music, Visual Arts
Health and Motion	Physical Education

The Slovak National Institute for Education (ŠPU) defines the ŠVP for a particular subject individually, regarding its general scope and educational content externalisation for a particular grade (including a definition of student content and performance standards). Regarding NETS*S, we analysed and categorised all explicitly defined activities (within the aims and externalisations of the particular subjects and pupil standards required), which support a development of pupil digital competence.

In the second phase we interpreted results and compared them with the subject equivalents of selected European nations (referring to the system of subjects within the Slovak primary education) and analysed using a cross-curricular comparison. The selected national curriculums were the Slovak National Educational Programme (ŠVP), Czech Framework Educational Programme for Basic Education (RVP ZV) and Primary Education Standard (SZV), English National Curriculum (NCE), Irish Primary School Curriculum (PSC), and Polish Early Childhood Education Curriculum in grades I-III primary school (PNEW), which represent a data basis for both phases that concluded in comparison and result interpretation.

4. Research results

Within the process of research, both research phases were conducted subsequently. The first research phase was oriented towards analytical results within Slovak primary grade subjects, with reference to reflect actual conditions. Diagnostics of explicitly defined and categorised digital competency within ŠVP allowed us to determine subjects of international comparison within selected East and West European nations, and to conduct analytical comparison (as the second research phase).

4.1. Digital competence within the Slovak national curriculum

Within the goals of primary education, digital competence is defined within practical DT usage in the learning process. Pupils are able to control the required software applications, communicate by e-mails, search and process information, develop algorithmic thinking, divide between reality and virtual reality and understand the risks related to ICT and network usage, adequately to their age. In particular primary grade subjects, a diverse representation of digital competence occurs within the general subject scope and mission, main subject goals and thematic goals, student content, and performance standards. In the following sections we interpret the findings about the concretisation within particular subjects, with regard to the point of reference.

According to our findings, a definition of digital competence within the general subject scope and mission is partially included within the subjects of Computer Science, Natural Science and Visual Arts. Other subjects show no explicit definition of digital competence. The ŠVP for the subject of Computer Science concretises the development of student digital competence (within the definition of subject mission) within student understanding of elementary terms, strategies and techniques for data-processing and data-flow in computer systems and the development of digital citizenship through the effective usage of DT following safe, legal and ethical policies. Within the subject of Natural Science, ŠVP concretises the development of student digital competence (within the definition of general subject scope) as follows:

- to practice elementary experiments using DT options;
- to indicate information about nature by observing, discovering and searching from a variety of information sources.

Finally, the ŠVP for the subject of Visual Arts concretises the development of student digital competence (within the definition of general subject scope) as students carry out elementary operations (typographic and textual tasks with specific drawing and painting tools).

4.1.1. Subject goals, thematic goals and standards required

Regarding the interpretation of the presence of explicit digital competence definitions, within the goals and required standards of particular Slovak subjects, analytical results are presented (Table 3). According to them, most Slovak subjects have no reference to digital competence within the definition of either subject goals (SG) or thematic goals (TG), or within content and performance standards (CPS). These subjects were Foreign Language, Geography, Ethics, Religion, Music, Visual Arts and Natural Science (although reference to digital competence in the general subject scope of Natural Science occurs).

Table 3 Presence of digital competence definition within Slovak subjects of ISCED1

Subject	**Subject goals (SG), Thematic unit goals (TG)**		**Content and performance standards (CPS)**
Slovak Language and Literature	SG	✓	No reference
Mathematics	SG	✓	No reference
Computer Science	SG	✓	✓
	TG	✓	✓
Physical Education	SG	✓	No reference
Practical Training	No reference		✓

Foreign Language, Geography, Ethics, Religion, Nature Science, Music, Visual Arts	No reference

In the case of Slovak language, Mathematics and Physical Education, digital competence is concretely defined within SG (all positive reference indexed by "✓"). The ŠPU for Slovak language defines digital competence (with regard to analytical categories) in pupil interaction, collaboration and publishing with peers, experts or others through the use of phone, SMS and e-mail usage (categorised within the 2nd analytical category). Mathematical SG defines pupil understanding and application of digital calculators and computers for organising, processing and obtaining information from a variety of sources (categorised within the 3rd analytical category). Physical Education defines SG so the pupils use DT for locational information (oriented towards sport activities) from a variety of information sources similarly (categorised within the 3rd analytical category).

Practical Training defines digital competence within content and performance standards, although no reference within SGs or TGs occurs. Digital competence is noted generally within the standards for the critical usage of DT for the realisation of practical solutions (categorised within the 4th analytical category).

Computer Science defines digital competence within both types of goals: SGs and TGs. Within SGs, digital competence is defined as follows:

- to learn and develop creative and aesthetic sentience by creating original works focused on the usage of supportive educational programmes and graphical editors (categorised within the 1st analytical category), concluding with pupil competence (within the CPS definition) in creating individual original works and drawings, and to process graphical works with an appropriate graphical editor;
- to understand options of systems for individual practical activities; to practice skills in PC usage (categorised within the 6th analytical category), concluding in pupil competence (within the CPS definition) in using elementary processes within applications for word-processing and presentation formation, organising folders and files productively, understanding and using input/output devices, and processing the recording and overplaying of audio and visual files.

TGs represent a wide scale of categorised digital competencies (five analytical categories included). They are concretised as follow:

- to use networks to communicate, support individual learning, contribute to the learning of others by collaborative problem solving, and process information (categorised within the 2nd analytical category), concluding in pupil competence (within the CPS definition) in using the options of e-mail (as content and performance standards);
- to apply digital tools for gathering, evaluation and usage of information by understanding the mechanisms for problem-solving (categorised within the 3rd analytical category), concluding in pupil competence (within the CPS definition) in planning strategies to guide enquiry by understanding the key-word definition process and its searching to locate and select the specific information required (word or image information), and to organise it systematically within files and folders and process data (regarding its data-type) and report the results;
- to understand the process of problem solving, and to plan, manage, realise implicit processes critically and make informed decisions using appropriate digital tools (categorised within the 4th analytical category), concluding in pupil competence (within the CPS definition) in understanding the terminology (algorithm, programme, programming) required, to realise partial problem-solving activities using algorithmic thinking, mechanisms and the potential of digital tools, and to identify the divergent parameters of effective solutions;
- to understand the ethical, moral and social aspects of DT, its potential risks and methods for their limitations and solutions (categorised within the 5th analytical category), concluding in pupil competence (within the CPS definition) in advocating a critical and responsible approach to the use of DT and information processing, to utilise interactive media responsibly by understanding the potential risks, to demonstrate personal responsibility for lifelong learning by understanding practical digital technology options, and to understand the security risks with internet usage;
- to demonstrate a sound understanding of digital technology mechanisms (categorised within the 6th analytical category).

4.2. Digital competence in the scope of European cross-curricular comparison

Considering our European cross-curricular comparison, we diversified particular Slovak primary grade subjects (SK) and allocated subject equivalents of other European nations: Czech Republic (CZ), Poland (PL), England (EN) and Ireland (IE), according to the correlative interference within subject content externalisation. The comparative results reflect two types of findings (Table 4).

Table 4 Cross-curricular reflection of digital competence within primary grade subjects

Subject	SG, TG					CPS				
	SK	CZ	EN	IE	PL	SK	CZ	EN	IE	PL
Mother Tongue	✓	✓	✓	✓	-	-	-	✓	✓	-
Foreign Language	-	-	✓	/	/	-	-	✓	/	/
Mathematics	✓	✓	✓	✓	-	-	-	✓	-	-
Computer Science	✓	✓	✓	/	✓	✓	✓	✓	/	✓
Nature Science	-	-	-	✓	-	-	-	✓	✓	-
Geography	-	-	✓	✓	/	-	-	✓	✓	/
Ethics	-	/	-	✓	-	-	/	✓	✓	-
Religion	-	/	✓	/	/	-	/	✓	/	/
Practical Training	-	-	/	/	-	✓	-	/	/	✓
Music	-	-	✓	✓	-	-	-	✓	✓	-
Visual Arts	-	-	✓	✓	-	-	-	✓	✓	✓
Physical Education	✓	-	-	-	-	-	-	-	-	-

Firstly, the range of digital competence definitions within the SG, TG and CPS of subjects in particular nations differs greatly (positive reference indexed by "✓", negative by "-", and no reference by "/"). According to the comparative results, Slovak primary grade subjects represent worse cases of digital competence definition within its subjects (n^{SK}=4 for SG and TG; n^{SK}=2 for SPC) in comparison with English and Irish definitions (n^{EN}=8 for SG and TG; n^{EN}=10 for CPS; n^{IE}=7 for SG and TG; n^{IE}=6 for CPS). For the Czech and Polish national curricula, the level of digital competence definition is relatively equal (n^{CZ}=3 for SG and TG; n^{CZ}=1 for CPS; n^{PL}=1 for SG and TG; n^{PL}=3 for CPS).

Secondly, the level of digital competence within particular Slovak subjects and their European equivalents differs from the point of view of the digital competence definition range (number of explicit mentions) and their content (specified according to NETS*S). From the point of view of the digital competence definition range, interferences within equal subjects are classified within the following types of cases:

- digital competence is widely defined within the SG, TG and CPS of a subject (as in the case of Computer Science);
- digital competence is widely defined within the SG, TG but less or not defined within the CPS of subject (in the case of Mother Tongue and Mathematics);
- digital competence is less or not defined within the SG, TG and CPS of subject (as in the case of Foreign language, Nature Science, Geography, Ethics, Religion, Music, Visual Arts and Physical Education);

From the point of the content of digital competence mentions, the findings present a divergence of what pupils are supposed to learn and acquire (according to the SG, TG and CPS). We can use the case of the subject of Mother Tongue (represented as "Slovenský jazyk a literatúra" in SK, "Český jazyk a literatura" in CZ, "English" in EN and IE, and "Edukacja Polonistyczna" in PL) as an example. Slovak ŠVP shows digital competence through the use of communication and collaboration skills, which is identical to the Czech RVP ZV and English NCE (references defined within SG, although no reference about this standard within CPS occurs). This is different to the Irish PSC (within the SG definition), according to which DT is implemented for the development of reading comprehension, information retrieval skills and word-processing in drafting, editing and rewriting (SG reflected within CPS, as well). In the case of the Polish PNEW, no reference occurs. Similarly divergent findings are practically visible within all subjects.

4.3. East and West European divergence

The level of digital competence definition shows East and West European cross-curricular divergence, although fractional mentions occur. Within the English and Irish national curricula (as representatives of West European nations), digital competence is well-represented within the combination of the SG, TG and CPS of all subjects (except Physical Education), with both range and content present. Most subjects include digital competence definitions within the goals and standards required for a sufficient level. Slovak, Czech and Polish national curricula (as representatives of East European nations) define digital competence in a reduced frame, although the intention to incorporate stimuli is evident in many cases (especially in the case of Slovak and Czech curricula).

Digital competence definition within performance and content standards of both West and East European nations differed greatly. Within the primary grade subjects (with no reference to Computer Science, where analytical categories of all nations are defined in a sufficient way), digital competence is, in the case of England and Ireland, defined in detail within the performance and content standards of all subjects (excepting Physical Education) in sufficient range and explicitly defined content (regarding the content of all the analytical categories NETS*S included). Slovak, Czech and Polish represent a digital competence definition within performance and content standards within primary subjects according to the first, fourth, fifth and sixth analytical categories of the NETS*S (excepting Computer Science, where all categories are defined well). Communication and Collaboration (as the second analytical category) and Research and Information Fluency (as the third analytical category) are not referenced within any of the subjects. Other references (mentioned above) are from the point of view of their definition range in comparison with the English and Irish cases.

5. Conclusions and Future Work

The strategy of digitalisation within Slovak regional education, as an initial impulse, reflects the options of pupil digital competence support within the available infrastructure, people and content. Findings present an outline of the problems of digital competence implementation. The level of digital competence and its insufficient definition within programmes of primary education causes an intra-European educational divergence, which may result in national educational recessions. As one of the preventative options, the Slovak national curriculum must react to innovative impulses resulting from actual social demands. Regarding the digital competence definition within the Slovak ŠVP and its international comparison, we recommend the following intra-curricular proposals:

- to involve content and performance standards, focussing on digital competence development according to the subject or thematic goals defined within particular Slovak primary grade subjects;
- to concretise innovative digital technologies involved within defined content and performance standards in detail;
- to consider the options for the implementation of subject goals, thematic goals and content and performance standards, which focus on the development of digital competence according to the specification within the equivalent subjects of European nations, with special focus on the West European representatives (English and Irish national curricula).

The results presuppose second project phase of dissertation thesis, which will reflect upon the practical implementation of digital competence within primary educational processes using an analysis of its limitations. This research presents plans to determine a standard for digital competence of primary education for both teachers and students of a primary teaching programme (as future teachers), and propose options for improvement.

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